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GEOPHYSICAL YEAR

by

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GEOPHYSICAL YEAR

PREPARATIONS for the International Geophysical Year, 1957-1958, are well advanced in the United States and other countries participating in the worldwide scientific survey that has been called man's most ambitious study of his physical environment. More than 5,000 scientists and engineers in some 55 nations are mobilizing equipment and supporting personnel for intensive investigations to be conducted simultaneously in all parts of the world.

The first fully equipped scientific expeditions set out for the Antarctic this month. By early January, 11 countries will have a chain of polar outposts in operation. The purpose will be to explore the world's least known continent and to carry out coordinated observations of atmospheric conditions in the south polar regions. The United States and the Soviet Union have developed plans for similar atmospheric observations near the North Pole which will be made from floating bases established on ice floes in the Arctic Ocean.

American and Soviet Work on Man-Made Moons

Progress has been reported by American scientists working on projects for exploration of the upper atmosphere by rockets and earth-circling satellites to be launched during the geophysical year. Russia has made no recent report on its similar project, but it is reportedly seeking to be the first to launch a man-made moon. Several nations, including Great Britain, France, and Japan, are preparing to join this country and the Soviet Union in shooting research rockets into the stratosphere and beyond.

Such projects are among the more spectacular tasks scheduled for the geophysical year. They represent only a small segment of the many related fields of investigation marked out for intensive and coordinated scientific research.

SCOPE AND TIMING OF WORLDWIDE INVESTIGATIONS

Activities planned for the geophysical year actually will extend from July 1957 through December 1958.[1] Into that 18-month period scientists expect to compress more than a score of years of normal research. The effort will be to fill important gaps in man's existing knowledge of the earth and its atmosphere and to learn how both are affected by the sun.

During the year and a half of intensive exploration, hundreds of observation posts will be linked in a worldwide network of scientific stations. The participating scientists will take measurements of the earth's core and crust, probe into its interior, track the course of deep ocean currents, observe weather and climate, and explore a variety of phenomena in the upper atmosphere. Many stations already in existence have been exchanging information for a number of years, but new stations will be established at remote points around the globe—on islands and on specially equipped ships in the Atlantic and Pacific, at points along the Equator, on ice floes in the Arctic Ocean, and on bases around the Antarctic continent.

An extensive chain of stations will take meteorological measurements in the stratosphere at heights not normally reached by balloon-borne instruments. New rocket-propelled instruments will record observations in the ionosphere at levels from 50 to 250 miles above the earth. The launching of artificial earth satellites is expected to enable man, for the first time, to explore the effects of solar activity at altitudes ranging from 200 miles to 800 miles.

Some of the most important and potentially useful projects are those relating to the overall effects of solar activity on the upper atmosphere. Solar flares and other eruptions from the sun create strange disturbances in the high atmosphere which interfere with long-distance radio communications, produce the brilliant aurora in the polar regions, and cause other phenomena of great significance to man. Earlier efforts to explore these phenomena were handicapped by inability of scientists to make direct observations and measurements at high altitudes during periods of intense solar activity.

[1] The Antarctic program will be kept in operation for 25 months—January 1957 to February 1959—in order to provide a longer overlap of observations and to permit replacement of personnel at remote south polar bases.

The 18-month period selected for the International Geophysical Year corresponds with a period of maximum solar activity as measured in terms of the 11-year sunspot cycle. Timing of observations in a variety of geophysical fields not only is related to the anticipated peak of sunspot disturbances, but also is designed to provide special opportunities for observing unusual spurts of solar activity that occur during this phase of the 11-year cycle. There will be special World Days when the entire chain of stations will observe and report on particular phenomena.

The general program calls for major projects in a dozen related geophysical fields and areas of activity, listed as follows by the United States National Committee for the International Geophysical Year:

Aurora and airglow	Ionospheric physics
Cosmic rays	Meteorology
Geomagnetism	Oceanography
Glaciology	Seismology
Gravity measurements	Solar activity

Longitude and latitude determinations
Rocket and satellite exploration of the upper atmosphere

Projects in all of these fields are interrelated. Simultaneous studies in oceanography, glaciology, and meteorology have to do with weather patterns and changes in climate. Knowledge of weather patterns has become increasingly important in the modern world. Improvement of weather forecasting—both short-term and long-range—thus is a major goal of projects in such scientific areas.

One primary objective of the polar expeditions, particularly those in the Antarctic, is to gain additional knowledge of the interrelationship of winds, ocean currents, and atmospheric changes which affect weather and climate. Lack of adequate data from the Antarctic continent and the oceanic regions surrounding it has seriously hampered progress in weather forecasting. Maintenance of almost 60 stations in Antarctic and sub-Antarctic areas during the geophysical year will provide adequate coverage of the Southern Hemisphere for the first time in history. Meteorologists then will be able to prepare daily weather maps of that vast region.

The Antarctic expeditions will furnish important new vantage points for observing the whole range of interre-

lated activity in the upper atmosphere. Scientists at bases in Antarctica will keep constant watch on the luminous waving lights of the aurora and will have special equipment for exploring effects of solar activity. They will observe the behavior of cosmic rays, record variations in gravity measurements and the earth's magnetic field, and correlate the findings with data gathered in rocket exploration of the upper atmosphere.

Rocket-borne cameras and electronic instruments are expected to provide a wealth of data never before obtainable. The complete records of worldwide observations will help answer hundreds of questions important to understanding the nature of the atmosphere and the effect of atmospheric disturbances on many kinds of human activity. What, for example, is the relationship between sunspots and interference with long-range radio transmission? Why does the aurora affect radio communications in the polar regions? What is the source of cosmic rays, and how are they related to other solar phenomena?

Answers to those and many other fundamental questions are primary objectives of the program. The answers in many fields may not be immediately forthcoming; data from all sources must be examined and correlated before scientific conclusions can be reached. But during the 18-month period of intensive observation, scientists expect not only to report important new discoveries, but also to make available new basic knowledge which will have practical applications in commerce and industry; in transportation on land, sea and air; in communication and navigational systems; and in many other aspects of daily life.

Efforts are being made to assure the widest possible dissemination of new scientific discoveries among the peoples of the world. Information collected at isolated observer outposts will be sent to centrally located stations to be analyzed and correlated with data from other sources. In the tradition of previous international scientific projects of this nature, results of the cooperative research during the geophysical year will be made available to scientists in all countries.

Results of Previous International Polar Years

Exchange of geophysical information between scientific bodies of various countries has been going on for many

years. The first great cooperative enterprise was the International Polar Year of 1882-1883, in which leading nations joined to carry out an intensive survey of conditions in the polar regions. On that occasion, expeditions were sent mainly to the Arctic to establish observation posts which achieved important results. The observations contributed to basic knowledge of the earth's magnetic field, the nature of the northern aurora, and weather patterns. Basic data then obtained still remain useful in geomagnetic studies. Practical applications of the knowledge gained at that time are found today in navigational equipment and weather devices that make travel safer by land, sea, and air.

A second International Polar Year was put on 50 years later, in 1932-1933, with the cooperation of many nations. Again, the primary area of exploration was the Arctic region, but scientific advances made it possible to take measurements in additional geophysical fields. Probably the most important findings during the second polar year were those relating to the ionosphere—the atmospheric belt stretching from a point 50 miles above the earth up to an elevation of 250 miles—which resulted in major advances in long-distance radio communication.[2]

The demonstrated value of the second polar year, combined with rapid strides in scientific techniques, encouraged the interested parties to promote the next international enterprise of the sort on a worldwide basis and to stage the event after an interval of 25 years instead of half a century. Proposals for a more comprehensive world survey were broached before three international scientific bodies in the summer of 1950. The project was endorsed by the International Council of Scientific Unions, which appointed a special committee the following year to coordinate planning of an overall program.

Each country participating in the global program is responsible for planning and executing its own scientific projects within broad lines approved by the international coordinating group. Most countries are developing their national plans through their own professional and scientific societies, which are recruiting top personnel for major

[2] Although Marconi had sent the first long-distance radio signals between Europe and North America at the beginning of the century, it was not until 1925 that Breit and Tuve demonstrated that the ionosphere acted as a reflector of radio waves, much as a mirror reflects light.

projects. Leading American scientists and engineers are working actively on all phases of the U.S. program, which is expected to make perhaps the largest and most spectacular national contribution.

Highlights of the United States Program

THE United States program for the International Geophysical Year is under the general direction of the National Academy of Sciences, the professional body which represents this country on the International Council. To draw up and carry out the detailed program, the Academy established a U.S. National Committee for the International Geophysical Year composed of outstanding scientists organized into special subcommittees and technical panels covering major fields of activity.[3] To help finance the program, the National Committee has been given federal funds through the National Science Foundation, the government agency established to promote and support basic scientific research in the national interest.[4]

The scope of the American program is far wider than indicated by the $39 million appropriated by Congress to date through the National Science Foundation. That sum, likely to be increased next year, covers only a portion of the actual expenses of scientific projects administered directly by the U.S. National Committee. It does not include the cost of important technical assistance and vital logistic support given by many government departments, particularly the defense establishments, nor does it reflect private contributions by universities and research institutions.

Total cost of the U.S. program has been estimated at somewhere between $150 million and $200 million, including all private and governmental outlays. Many universities are contributing the services of their top scientists and

[3] Chairman of the U.S. National Committee is Joseph Kaplan, a leading geophysicist of the University of California at Los Angeles; A. H. Shapley of the National Bureau of Standards is vice chairman.

[4] The National Science Foundation, created by act of Congress in 1950, is a government research agency wholly supported by federal funds, whose officers and board are appointed by the President with advice and consent of the Senate. The National Academy of Sciences, on the other hand, is a quasi-official but privately administered scientific body established in 1863 under a congressional charter which specified that it was not to receive direct financial aid from the government.

making research facilities available without cost to the government. Federal agencies are contributing personnel and technical facilities, including observatories, weather stations, and research equipment in addition to the engineering assistance and logistic support given by the defense establishments to the polar expeditions and the rocket and satellite projects.[5]

The most extensive and spectacular projects in the American program are the polar expeditions and the rocket and satellite explorations of the upper atmosphere. These may absorb as much as 90 per cent of total outlays, with the satellite launchings alone taking about one-half of the federal funds available for the United States effort. Some scientists, feeling that spectacular projects are not necessarily the most useful, have been critical of the allocation of funds. Others have defended the apportionment on the ground that the polar expeditions and rocket and satellite projects will enable scientists to make sustained observations of the whole range of scientific fields in regions hitherto beyond the reach of man.

Antarctic Activities and Polar Explorations

Reversing the emphasis on Arctic exploration which dominated earlier polar years, the United States is giving top priority to the vast Antarctic continent in its current polar program. But the northern regions have not been neglected. They will be the subject of intensive experiments conducted at a chain of stations already established in Alaska, at additional stations operated jointly with Canada, and at two U.S. Navy-operated stations on drifting ice floes in the Arctic Ocean.[6] But in the south polar regions, the United States already has launched its ambitious Operation Deepfreeze.

The Antarctic covers an area of six million square miles, about equivalent to the combined areas of the United States and Europe. Sheathed in perpetual ice and snow, it is the world's coldest region and least-known land area. Many parts of the interior plateau, averaging about 6,000 feet above sea level, have never been explored.

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[5] The U.S. National Committee has turned over to the Department of Defense direct responsibility for all support operations in the Antarctic and for engineering and logistics phases of the rocket and satellite projects.

[6] This country's floating stations in the Arctic will be equipped to make meteorological observations and solar radiation measurements.

Preparations for activities in the Antarctic began in the winter of 1954-1955, when the U.S.S. *Atka* made a four-month voyage to explore conditions along the coastal ice shelf and to find a location for the main American base near earlier Little America sites in the Ross Bay region. The winter of 1955-1956 saw departure of the first Antarctic expedition, called Operation Deepfreeze I, with men and equipment to start construction of the six scientific bases to be operated by the United States. This year has seen completion of the new Little America base at Kainan Bay on the western edge of the Ross Sea ice shelf. Interior stations also are to be ready for occupation by the main expedition when it arrives in January 1957.

In addition to the principal operational base at Little America, the United States will have fully equipped outposts at Byrd Station in Marie Byrd Land, on the plateau at the South Pole, at the edge of the Weddell Sea on the Atlantic side of the continent, at Knox Station in Wilkes Land south of the Indian Ocean, and at Adare Station (operated jointly with New Zealand) on the eastern edge of the Ross Sea. The entire network of American Antarctic stations is to be served by the Williams Air Operation Facility on Ross Island in McMurdo Sound. The facility went into operation in mid-October, when advance units of the expedition were flown there from New Zealand. A plane which on Oct. 31 made the first landing of an aircraft in history at the South Pole itself took off from the Williams base.

By the end of next January, the scientific, technical, and support personnel at the six stations and the air facility will number 148 men. The scientific programs will be in the hands of 95 scientists and technicians distributed among the individual stations. Including support personnel, the contingents at the stations will range from 50 men at Little America, the largest base, to 15 at the Pole station and 12 at Adare, the smallest outpost.[7]

The operation in Antarctica will be carried out during two overlapping periods, each lasting approximately 18 months. The first expedition contingent, due at Little America in January 1957, will remain at the stations until

[7] The U.S. Navy is providing additional support personnel at the largest stations and for air operations, including airlifts between bases and between Antarctica and the United States.

late February 1958. This contingent will then depart for home, arriving in the United States two months later. The second contingent, leaving this country in November 1957, will arrive in Antarctica a month before the first expedition returns, thus allowing time for rotation of personnel and coordination of programs. The second group will continue operations until February 1959, when it will start back to this country, arriving in April of that year.

PRIMARY TARGETS OF U.S. OPERATION DEEPFREEZE

Primary scientific targets have been set up for the U.S. Antarctic expedition in eight of the 12 major fields to be covered in the worldwide program. Stations in the south polar regions are to be staffed and equipped to conduct investigations in glaciology and meteorology which are expected to contribute new knowledge of weather patterns in the whole Southern Hemisphere. The participating scientists will make gravity measurements, study the magnetic field of the earth and its variations (particularly important in navigation), measure the thickness of the polar icecap, and explore the whole range of solar activity.

The South Pole station will serve as an important halfway point for traverse parties scheduled to cross the Antarctic continent from bases on opposite coasts. The largest glaciers in the world are found in Antarctica; they are believed to influence the weather in remote parts of the earth. Holes will be drilled in some glaciers to a record depth of 1,000 feet, and ice samples taken, temperatures measured, and the age of ice layers estimated. Information thus gained will help to determine the rate at which the polar ice cap is melting, and may indicate whether a resulting rise in the ocean level may some day flood low coastal areas.

High priority has been given to exploration of the upper atmosphere from the unusual vantage point of the Antarctic. Soundings of the ionosphere will be made for the first time from that region, where strange disturbances can be observed under contrasting conditions of the Antarctic summer and the long winter months of complete darkness.

Systematic observations of the aurora will be made in both the Antarctic and the Arctic. Scientists hope to establish correlations between the two polar regions and

define relationships between the aurora and other disturbances which stem from solar activity. Correlated findings are needed not only to supplement the very limited data available for basic scientific research, but also to predict the amount and kind of disruptions encountered in radio communications.[8]

A small but pioneering program of rocket exploration is to be carried out in the Antarctic. A series of measurements will be made by rockets fired from balloons which are expected to reach an altitude of about 50 miles. This equipment will be used for experiments in cosmic rays, aurora, and geomagnetism.

Equipment to be used for the first time in the Antarctic includes a newly-developed "all-sky" camera which can photograph from horizon to horizon and take motion pictures of the aurora in all its changing phases. The camera will provide complete and accurate records of Antarctic observations for comparison with similar records gathered in the Arctic and other regions.

An Antarctic "Weather Central" will collect, analyze, and disseminate weather reports received from meteorological stations in the region. It is expected that weather reports will be picked up from stations of all 11 countries cooperating in the Antarctic program, and that additional reports will come from expedition ships, whaling vessels, aircraft, and transit parties on the polar ice cap.

The reports received at Weather Central will be correlated in comprehensive regional weather reports and made available to established stations in Africa, Australia, New Zealand, South America, and other parts of the Southern Hemisphere, and to all major international weather agencies. It is hoped that the Antarctic weather maps, when analyzed in connection with data obtained in other parts of the Southern Hemisphere, will fill up blanks in existing weather information and make possible the development of an effective forecasting system.

Investigations of current weather conditions in the Antarctic and other regions are related to wider explorations of deep ocean currents that affect weather and climate in

[8] Auroral disturbances to radio communications have caused serious trouble for pilots flying across the North Atlantic and in northern Alaska.

all parts of the world. Oceans cover 71 per cent of the earth's surface, and the currents of the oceans are moving constantly in huge circulatory systems that vitally affect the climate of the 29 per cent of land surface.

Explorations of Ocean Currents and Climate

Probing the deep ocean currents is a major objective of the oceanographic program for the geophysical year. Virtually nothing is known about the currents except at the very surface of the sea. The surface course of vast currents moving from the polar regions to the Equator has been plotted, but there is so little knowledge of this circulatory system that it is not now possible to say whether it takes 100 years or 10,000 years for the deep water to travel to the Equator and back again.

Knowledge of the behavior of deep water currents is important in long-range weather forecasting. Scientists are interested also in the rate at which deep waters rise to the surface, because those waters replace and fertilize the top levels which furnish fish and other seafood. An additional objective is to discover whether radioactive wastes can be disposed of safely at the bottom of ocean deeps. The rate of circulation and turnover of ocean currents may be such as to constitute a hazard to marine life and to man if this method of disposal is attempted.

The United States is making a major survey of the deep water circulation of both the Atlantic and the Pacific oceans. This will include measurements of the water moving northward from Antarctica into the Atlantic and Pacific, and along the bottoms of those oceans to the equatorial belt. It wi'l include also detailed studies of the rise of bottom water to the surface in the northern Atlantic, and its subsequent sinking and movement toward the Equator. U.S. oceanographic ships will cooperate with vessels of other countries in the various deep water programs.[9]

Rocket Experiments in the Upper Atmosphere

The need for accurate information from the upper atmosphere calls for direct measurements which can be made only by instruments capable of reaching high altitudes and recording scientific data. Until recently direct observa-

[9] In addition to U.S. government ships, research vessels of the Scripps Oceanography Institution and the Lamont Geological Observatory are to participate in expeditions planned for 1957 and 1958.

tions could not be made above a height of around 25 miles—the upper limit of conventional balloon devices used in weather operations. However, rocket development during and after World War II has produced a variety of new devices capable of effective use for scientific research at very high altitudes. Balloon-launched rockets, called "rockoons," can reach heights of 50 to 60 miles. Larger, ground-launched rockets have maximum ceilings three or four times higher. The Aerobees, which have been assigned to the U.S. rocket program, can reach an altitude of approximately 200 miles.

During the geophysical year the United States will launch some 600 rockets from sites in this country and from stations overseas. Most of the high-altitude rockets are to be fired from Fort Churchill, Canada, in cooperation with Canadian scientists, and from White Sands and Alamogordo, N. M.[10] Balloon-borne rockets will be launched from ships in many areas, including equatorial regions and waters of the Arctic and Antarctic. Small rockets, called "rockairs," will be launched from airplanes. Another type of rocket, the Nike-Deacon, will be launched from the ground in two-stage combinations.

Although rockets are expected to yield much new information about phenomena in the upper atmosphere, scientists have pointed out that they have two limitations: (1) Their total flight is of extremely short duration and the time spent at a particular altitude is even shorter; (2) the area that can be surveyed by instruments in a rocket is a very small part of the earth's atmosphere. Consequently, a device capable of supplying data over a long period of time, at considerable heights, and over large expanses of the earth was sought. Such a device has been developed in the earth satellite, which this country expects to launch at some time during the 18 months of the geophysical year.

Plans for Launching the First Earth Satellite

The project to launch an artificial satellite in an orbit around the earth, first announced by President Eisenhower on July 29, 1955, has passed the planning phase and is now in the stage of active development. Responsibility for developing, constructing, and launching a vehicle capable of girdling the earth was assigned to the Office of Naval

[10] Preliminary rocket firings began last month at Fort Churchill.

Research, which established Project Vanguard to undertake the engineering task and provide logistic support.[11] Scientists in public and private research institutions are cooperating with the U.S. National Committee on scientific aspects of the program.

Current plans call for launching of about ten satellites by the United States. Launchings will be from the Patrick Air Force Base at Cape Canaveral on Florida's east coast. Operation of the complex launching device has been described by Joseph Kaplan, chairman of the U.S. National Committee, as follows:

> A three-stage rocket assembly will provide the means of getting the satellite into its orbit. The first stage, providing a thrust of 27,000 pounds, will start the system on the first part of its flight. When its fuel is exhausted, some 40 miles from the launching site and within about two minutes after take-off, the system will have attained a velocity of about 3000-4000 miles per hour.
>
> The second-stage rocket will then take over, attaining a velocity of about 11,000 miles per hour, burning out at about 130 miles altitude, and coasting onward. When the system has reached an altitude of about 300 miles, the last rocket will impel the satellite into its orbit at a speed of about 18,000 miles per hour.[12]

No date has been announced for launching the first man-made moon, and there have been recurrent reports that Project Vanguard is lagging behind schedule. Official spokesmen have pointed out that unprecedented engineering problems are involved, and that some technical difficulties remain to be overcome; but they deny that any problems now foreseen are such as to defy solution within the established deadlines. The rocket motors for all three stages are said to have had test runs, and the first satellite sphere has already been produced.[13]

Difficult technical problems related to placing the satellite in its planned orbit, and to tracking the actual course of the man-made moon once it is circling the earth, still have to be worked out. After the satellite has been propelled

[11] All three armed services are participating in the satellite project under the administrative management of the Naval Research Laboratory.

[12] The first instrument-carrying satellite will be a small metal sphere, between 20 and 30 inches in diameter, weighing approximately 21.5 pounds. About half of that weight is required for the structure itself, leaving only a litt'e more than ten pounds for the complex instruments to take measurements in the upper atmosphere and transmit data to the earth. The equipment includes devices for making meteoritic observations, taking temperature and pressure readings, and measuring cosmic ray intensities and ultra-violet radiation from the sun. A telemetering system will transmit information by radio signals to ground stations.

[13] Development and construction work on the launching vehicle and satellite is being carried on at the U.S. Naval Research Laboratory in Washington, and under contract at the Glenn L. Martin Co. plant near Baltimore.

into space by the third-stage rocket, it must proceed under its own momentum around the earth at a speed and in an orbit which will enable the sphere to withstand the pull of the earth's gravity. To serve its scientific purpose, the course of the satellite must be tracked and recorded.

The projected speed of 18,000 miles an hour is calculated to produce centrifugal force sufficient to counteract the gravitational pull. The planned orbit will permit the satellite to revolve about the earth in an ellipse at a height ranging from 200 miles to 800 miles. This orbit will take the sphere around the earth once every 90 minutes in an apparent latitude range of about 40 degrees on either side of the Equator. Choice of an elliptical orbit around the Equator is said to have two advantages: (1) The satellite's instruments will be able to record observations over a broad expanse of the high atmosphere; and (2) the wide band-width coverage will enable watchers in many countries to take scientific measurements of the course of the artificial moon.

The first satellite should be observable from most of the United States south of the 40th parallel, which runs slightly north of San Francisco through Boulder, Colo., and Philadelphia. The satellite will pass over southern Europe, the Caspian Sea, and Russia's southern borders, and will be observable from India, China, Japan, Australia, and New Zealand, as well as from all equatorial lands, most of Africa, and parts of South America.[14]

Scientists are not quite certain that the tiny artificial moon will be visible to the naked eye. Under optimum conditions, the first satellite will appear from the ground about as large as a golf ball shot from a jet plane at 60,000 feet. But its bright metal surface will reflect the sun's rays, and American scientists believe that it will be possible to see it for brief periods just before dawn and immediately after sundown.[15]

[14] The U.S. National Committee plans to use other orbits for later launchings.

[15] At best, the reflected light of the satellite is expected to be about that of a sixth-magnitude star, the dimmest star visible to the naked eye.

Foreign Plans for the Geophysical Year

VIRTUALLY ALL of the 55 countries participating in the International Geophysical Year are making preparations to cooperate actively in some phase of the global scientific undertakings. Some small countries lack the resources and facilities to organize elaborate national programs of their own, but even the smallest of them are contributing observer teams or making stations available for cooperative ventures with other countries.

Most of the big countries are planning extensive national programs. During the last meeting of the international coordinating body at Barcelona, Spain, in September 1956, a number of leading countries announced scientific undertakings matching those of the United States in some fields of investigation.

Separate and Joint Projects of Leading Nations

A score or more leading nations have scheduled projects in all 12 fields of scientific exploration. Perhaps the most extensive national programs, apart from that of the United States, will be those planned by Great Britain and members of the British Commonwealth; by France, Italy, Japan, West Germany; and by the Soviet Union. Each of those countries is to carry out rocket explorations of the upper atmosphere, conduct experiments in related fields of solar activity, measure ocean currents, or send expeditions to the polar regions.

The 11 nations with expeditions in the Antarctic (Argentina, Australia, Chile, France, Great Britain, Japan, New Zealand, Norway, South Africa, Soviet Union, United States) will establish more than 30 bases and scientific stations around the south polar continent. Several expeditions plan to cross the Antarctic continent, traversing unexplored regions of the high polar plateau with stopovers at the U.S. South Pole Station. A British Commonwealth expedition will make a trek by sled and snow vehicle from the Weddell Sea area on the Atlantic side to a New Zealand base on the Pacific side. The Russians are preparing an inland base at the geomagnetic pole, about 800 miles from the geographical pole.

The cooperative nature of important scientific projects is underlined by the sharing of technical facilities among participating countries in different parts of the world. Many nations are cooperating with the United States to maintain joint observation posts in the Western Hemisphere. Canada is sharing nine stations with this country for high altitude measurements and rocket tests. In Mexico, Cuba, Central and South America, and in the Caribbean, some 20 stations are to be operated on a cooperative basis.

In the North Atlantic and Arctic regions the United States has been offered special facilities for solar observations at stations maintained jointly with Britain, France, West Germany, Greenland, and Iceland. In the Pacific this country has cooperative arrangements to share observation posts with Japan, Korea, and the Philippines.

Extent of the Soviet Union's Scientific Activities

One of the largest and most ambitious national programs is that of the Soviet Union. At the Barcelona meeting last September, the Russians outlined a program of extensive activity in every field of investigation with particular emphasis on rocket and satellite projects, polar explorations, and geomagnetic and solar observations.

The Soviet Union is the only country competing with the United States to launch an earth satellite. Soviet scientists have announced no date for the launching attempt and have disclosed few technical details of the Russian satellite project. They simply notified the international committee at Barcelona that Russia planned to launch a satellite at some time during the geophysical year.[16] They said their artificial moon would be fully instrumented for observations in the upper atmosphere; it would carry telemeter equipment which could be tuned to the same radio frequency the United States planned to use for reporting back to the earth. But nothing was said about the launching vehicle, the nature of the satellite itself, or the orbit into which it would be projected.

Fragmentary reports published in Soviet scientific journals have indicated to western scientists that the Russians are working on a three-stage rocket capable of reaching a

[16] Moscow newspapers revealed as early as Apr. 15, 1955, that the Soviet Union was working on an artificial satellite, but no formal announcement was made prior to the Barcelona meeting.

maximum speed of 20,000 miles an hour in the third stage. The Soviet satellite is believed to be somewhat larger than the first sphere being built by the United States. It is expected that it will be projected into a polar orbit which will carry it in an ellipse around the Arctic Circle.[17]

Russia's overall program for the geophysical year has been organized by a national committee set up by the Soviet Academy of Sciences. According to Soviet statements to the international coordinating group, the Russians will have close to 300 stations and observation posts scattered across the U.S.S.R. Two Soviet ice-floe stations are reported already in operation in the Arctic; a number of floating stations on ships in the Pacific, the North Atlantic, and the Arctic oceans are planned.

INTEREST OF GOVERNMENTS IN GEOPHYSICAL RESEARCH

Governments of all the participating countries have endorsed the broad objectives of the International Geophysical Year, and most of them have contributed substantially to the support of major research projects. President Eisenhower has called the worldwide undertaking "a striking example of the opportunities which exist for cooperative action among the peoples of the world." Sen. Warren G. Magnuson (D-Wash.), chairman of the Senate subcommittee which approved funds for the U.S. program, termed the international effort vital to the interests of this country and of "vast importance to the welfare of mankind."

Leading scientists, stressing the "pure science" objectives of the international program, have pointed to the importance of advancing man's knowledge of his environment. Many governments, including those of the United States, Great Britain, and the Soviet Union among others, have appropriated sizable amounts for basic research phases of the program. Most of the governments, however, have made their chief financial grants to projects which seem likely to have early practical application or which relate at least indirectly to vital national security interests.

More than one-half of the funds appropriated by the American government has been allocated to the rocket and

[17] A north polar orbit would make the Soviet satellite visible from Canada and northern United States, northern Europe, and along the entire length of the Soviet Union from the Baltic Sea to the Pacific Ocean.

satellite projects, in which the defense establishment is playing an important part. Western scientists familiar with Moscow's program estimate that the bulk of the Russian funds is going into the satellite project and polar research.

Polar explorations in both the Arctic and the Antarctic involve national defense considerations or have important political implications for a number of countries. The Soviet Union has been building a chain of permanent bases for both scientific and defense purposes along the entire length of its Arctic frontiers. The United States and Canada are cooperating in erecting a 3,000-mile radar defense line extending from Point Barrow, Alaska, to Baffin Island north of the Arctic Circle.

The Antarctic has assumed increasing strategic importance with the development of air power. Many nations have conflicting territorial claims there. Despite such rivalries, most participating governments have lauded the cooperative nature of the International Geophysical Year. Several countries are preparing information programs to explain the objectives of the enterprise to their own and other peoples. The United States Information Agency is assembling a series of exhibits for overseas showing to illustrate how this country is applying its scientific genius in peaceful research to extend the frontiers of knowledge.